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13. ABSTRACT *(Maximum 200 words)*

Optical fiber corrosion sensors are being developed to address the high service costs associated with current structural maintenance procedures of civilian and military assets. A distribution optical fiber sensor system will help reduce the costs associated with corrosion damage and extend the lifetime of existing assets. Annual national losses in time, labor, materials, and systems have been estimated in the billions of dollars. Additional costs arise from system downtime that results from disassembly procedures to locate corrosion damage in remote locations. Furthermore, the potential to damage other system parts during maintenance is increased when disassembly and reassembly occur. The development of on-line optical fiber sensors capable of detecting corrosion would eliminate a significant portion of the maintenance costs. We present recent test results using optical fiber long-period grating (LPG) corrosion sensors. With the appropriate coating, the sensors can be designed to detect water, pH or metal-ions in otherwise inaccessible regions of the aircraft. The LPG sensors can be rendered immune to temperature cross-sensitivity, multiplexed along a single fiber, and can be demodulated using a simple, low-cost spectrum analyzer.

14. SUBJECT TERMS

optical fiber sensors, hydrogels, corrosion sensors, long period gratings
Nondestructive evaluation, aging aircraft

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OPTICAL FIBER-BASED CORROSION SENSORS FOR AGING AIRCRAFT

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ABSTRACT

Optical fiber corrosion sensors are being developed to address the high service costs associated with current structural maintenance procedures of civilian and military assets. A distributed optical fiber sensor system will help reduce the costs associated with corrosion damage and extend the lifetime of existing assets. Annual national losses in time, labor, materials and systems has been estimated in the billions of dollars. Additional costs arise from system downtime that results from disassembly procedures necessary to locate corrosion damage in remote locations. Furthermore, the potential to damage other system parts during maintenance is increased when disassembly and reassembly occurs. The development of on-line optical fiber sensors capable of detecting corrosion would eliminate a significant portion of the maintenance costs. We present recent test results using optical fiber long-period grating (LPG) corrosion sensors. With the appropriate coating, the sensors can be designed to detect water, pH or metal-ions in otherwise inaccessible regions of the aircraft. The LPG sensors can be rendered immune to temperature cross-sensitivity, multiplexed along a single fiber, and can be demodulated using a simple, low-cost spectrum analyzer.

KEY WORDS: optical fiber sensors, hydrogels, corrosion sensors, long period gratings, nondestructive evaluation, aging aircraft

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OPTICAL FIBER BASED CORROSION SENSORS FOR AGING AIRCRAFT

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The Second Joint NASA/FAA/DoD
Conference on Aging Aircraft
Williamsburg VA
Aug 31 - Sep 3

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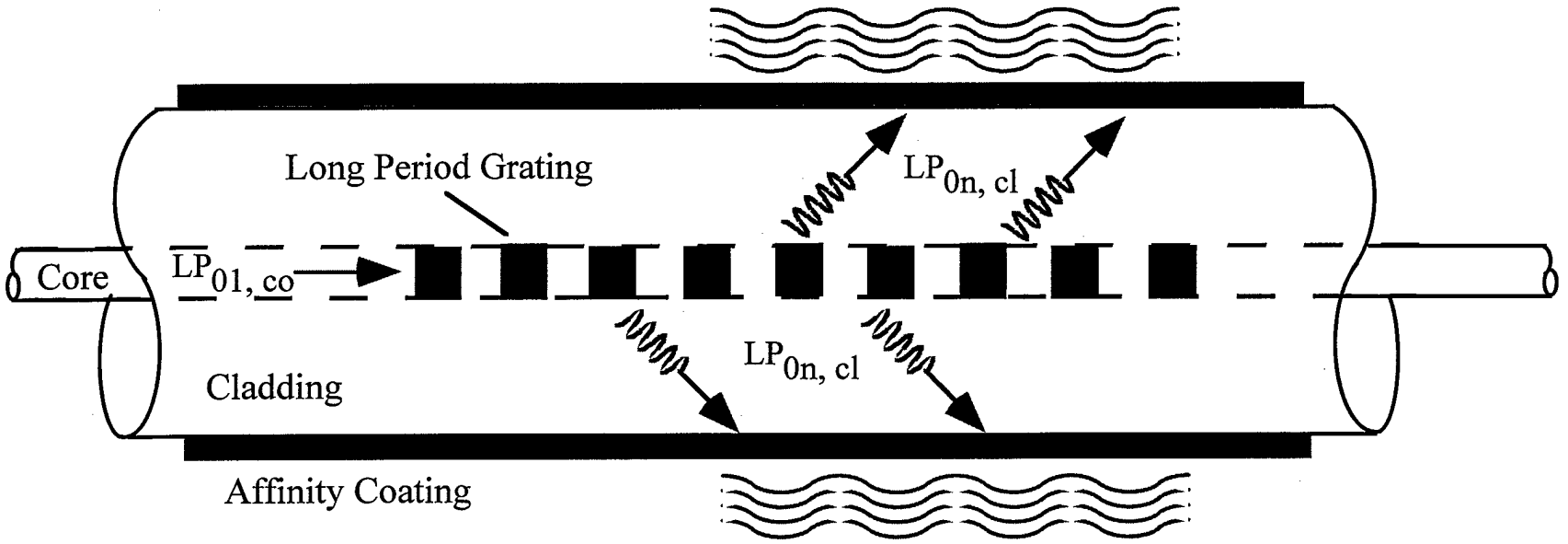
LPG Corrosion Sensor F&S



$$\Delta\beta = \frac{2\pi n_{core}}{\lambda} - \frac{2\pi n_{cladding}}{\lambda} = \frac{2\pi \Delta n}{\lambda} \quad \Delta\beta = \frac{2\pi}{\Lambda}$$

(by definition)

(phase-matching condition)

$$\lambda = \Delta n \Lambda$$

(governing equation for LPG sensor)

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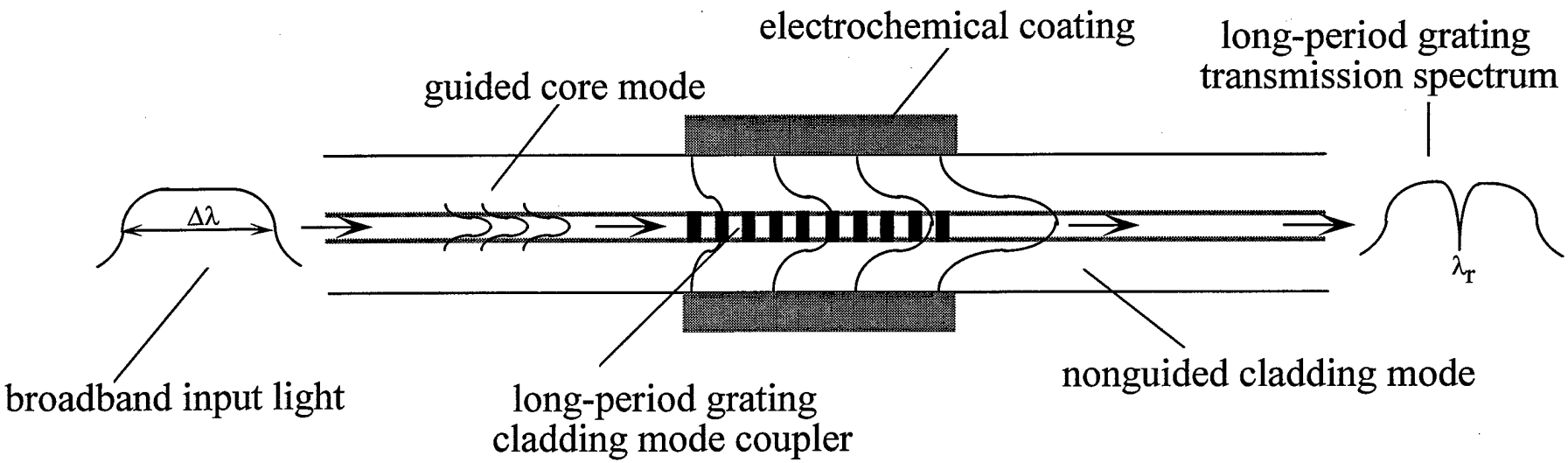
LPG-Based CorrosionSensor F&S



- F&S owns joint patent on LPG sensor with Lucent Technologies

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LPG Moisture Sensor in Water Bath

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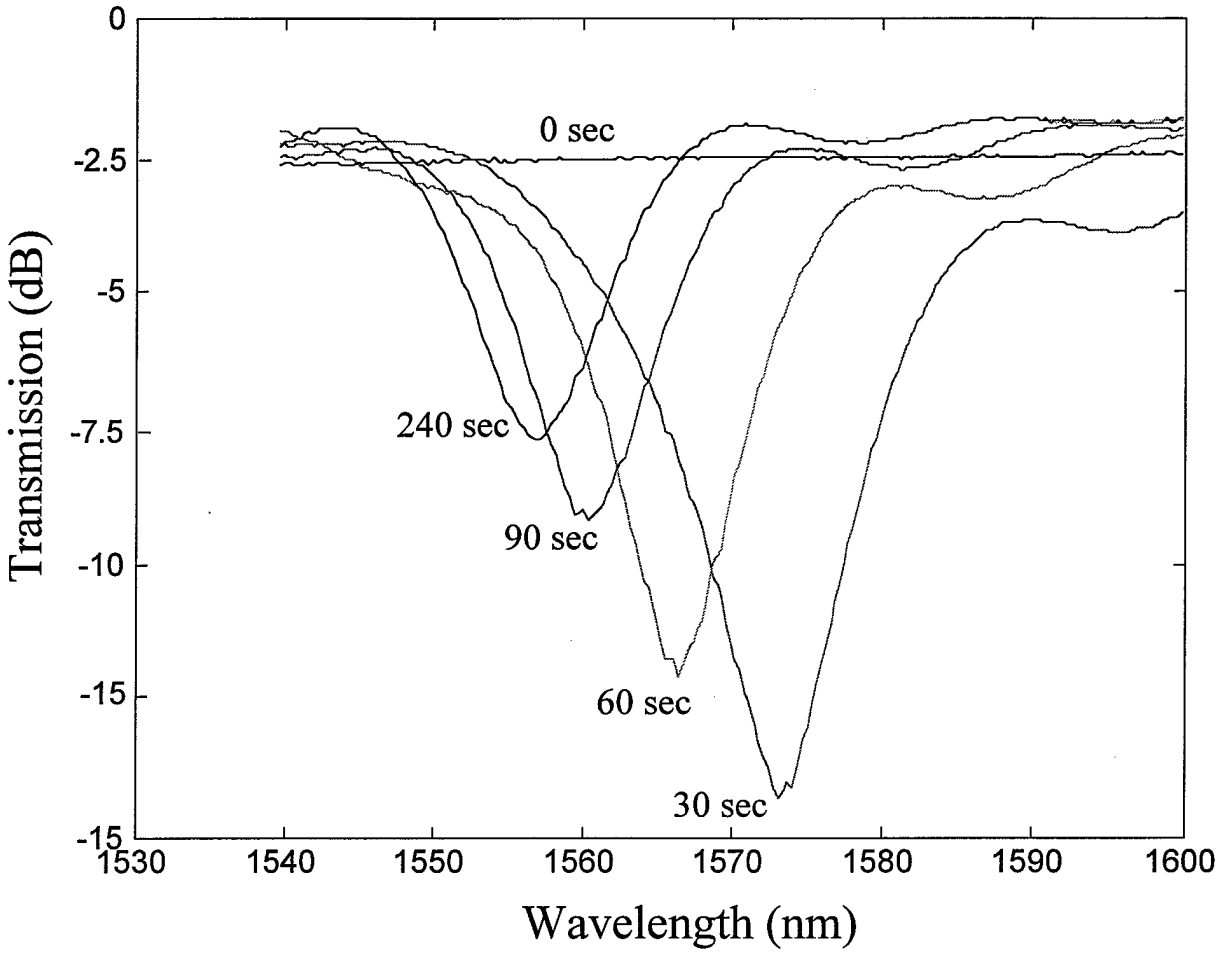

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LPG Sensor after Removal from Water Bath

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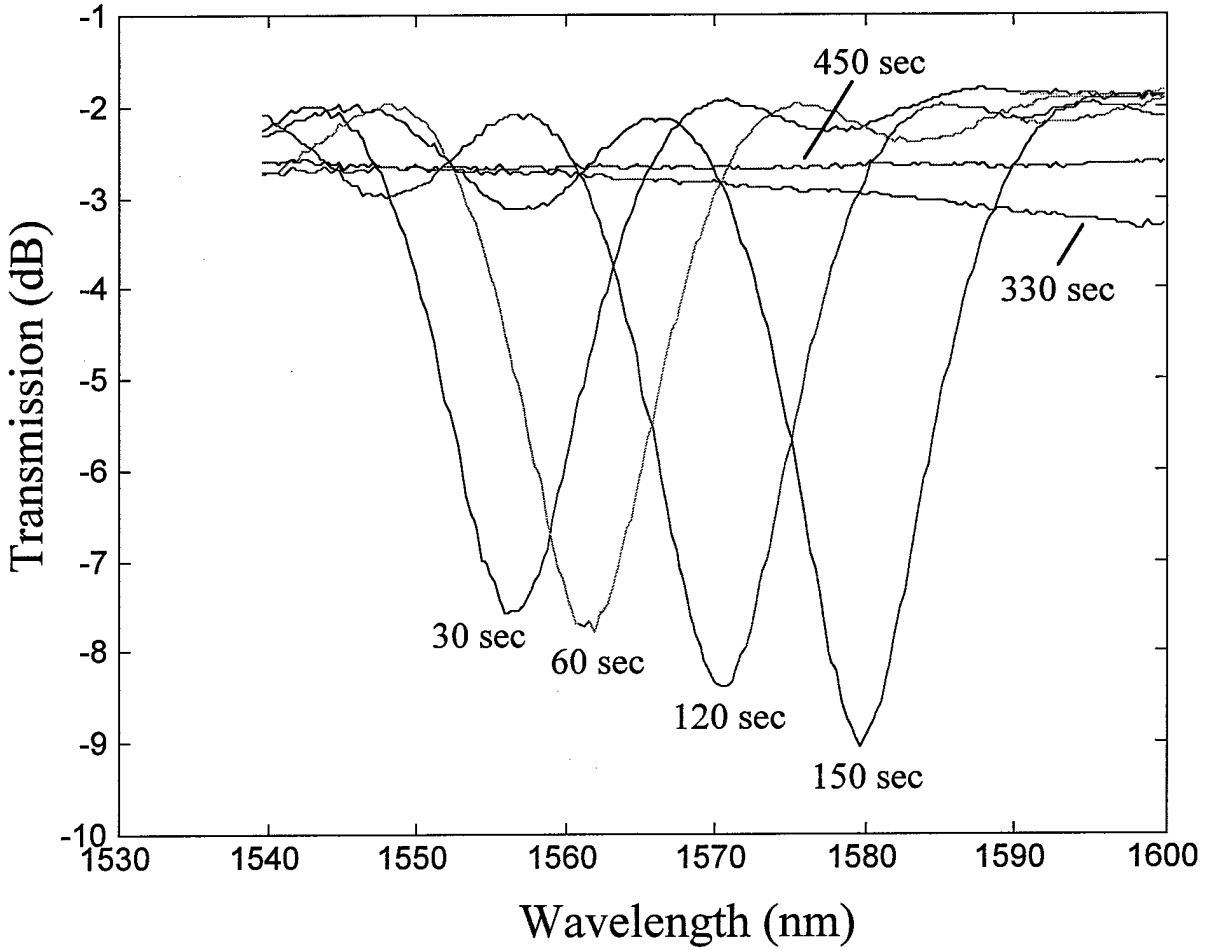

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Time History of LPG during Water Tests

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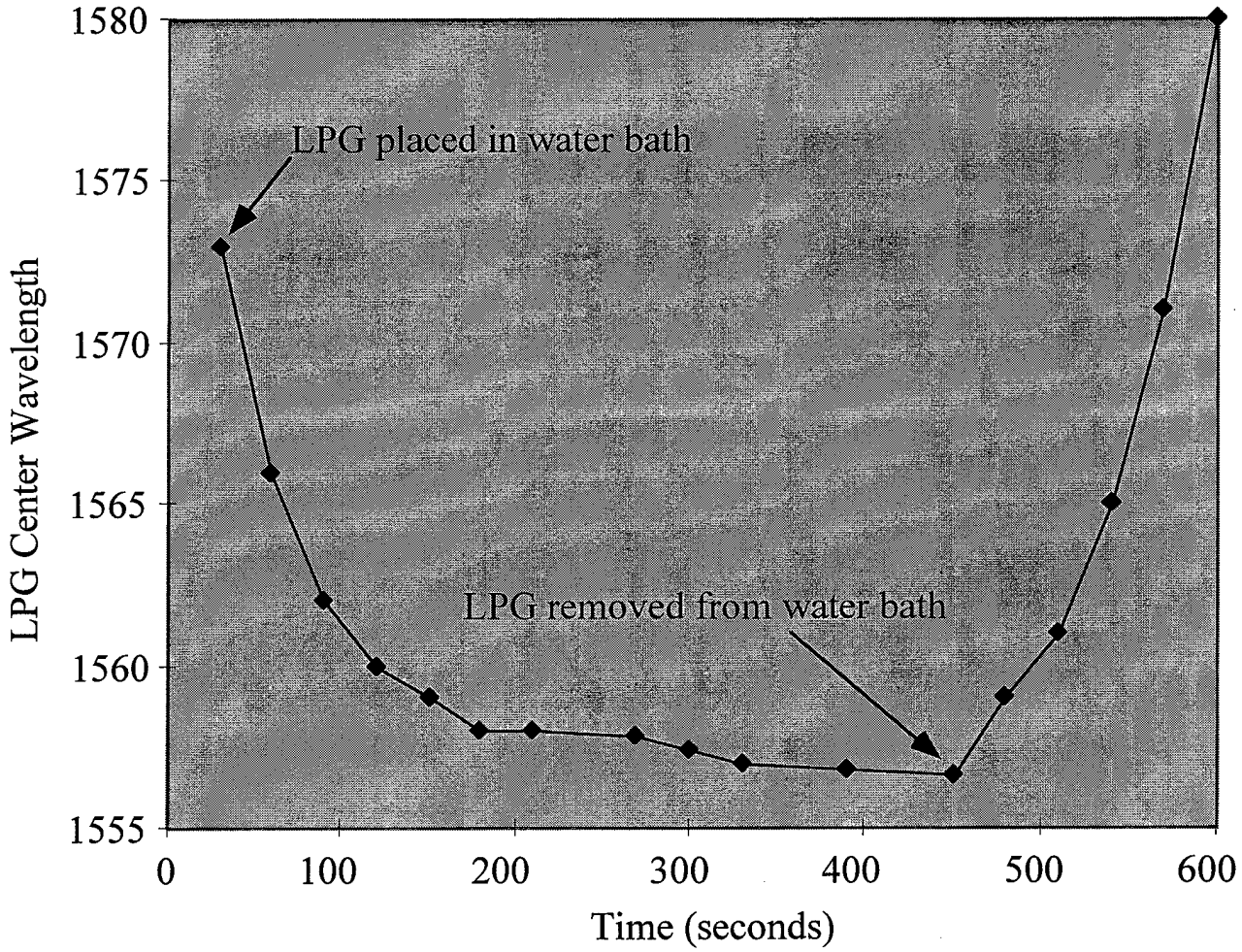

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5 Multiplexed LPG Corrosion Sensors

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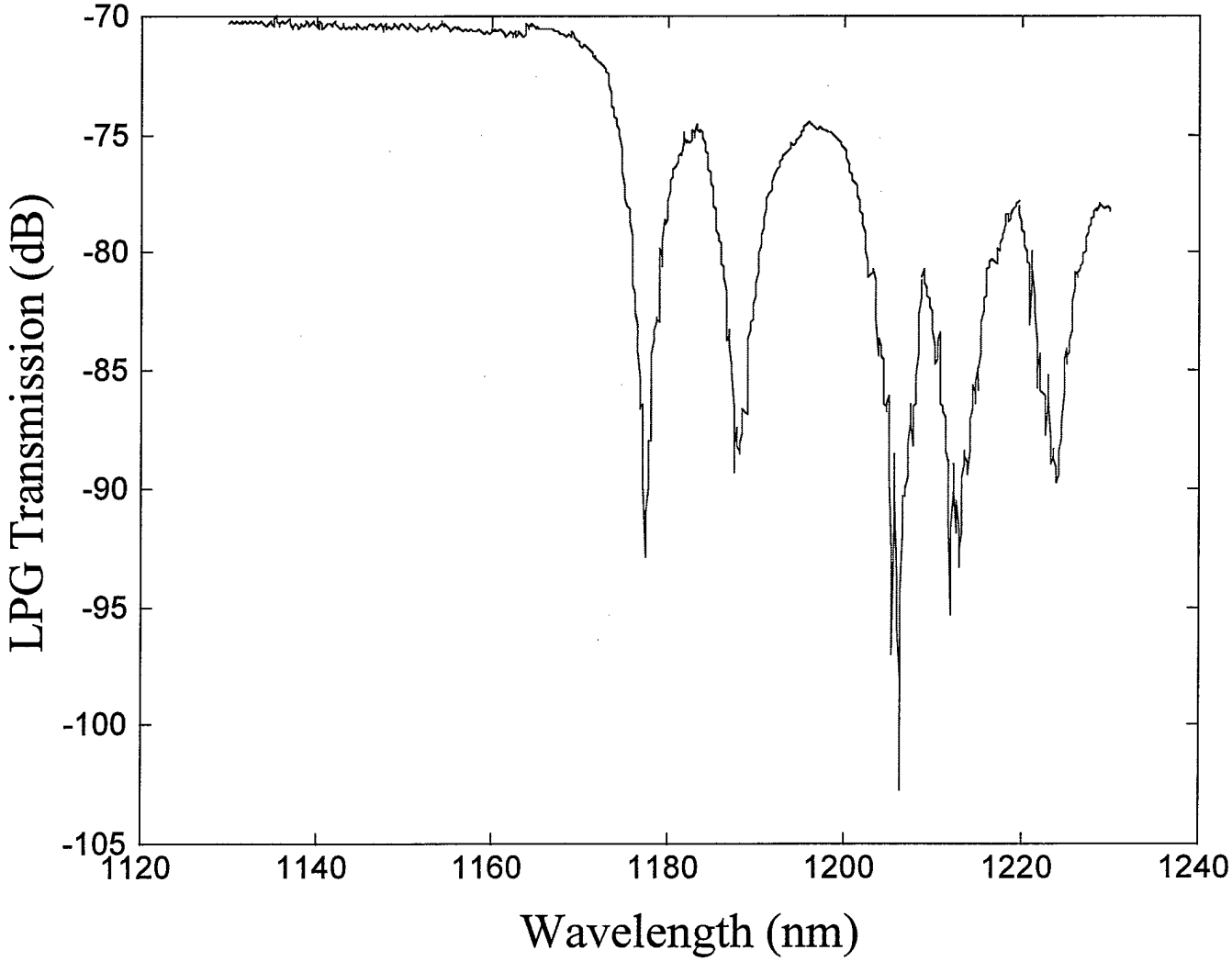

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Hydrogel-Coated LPG Magnesium Sensor

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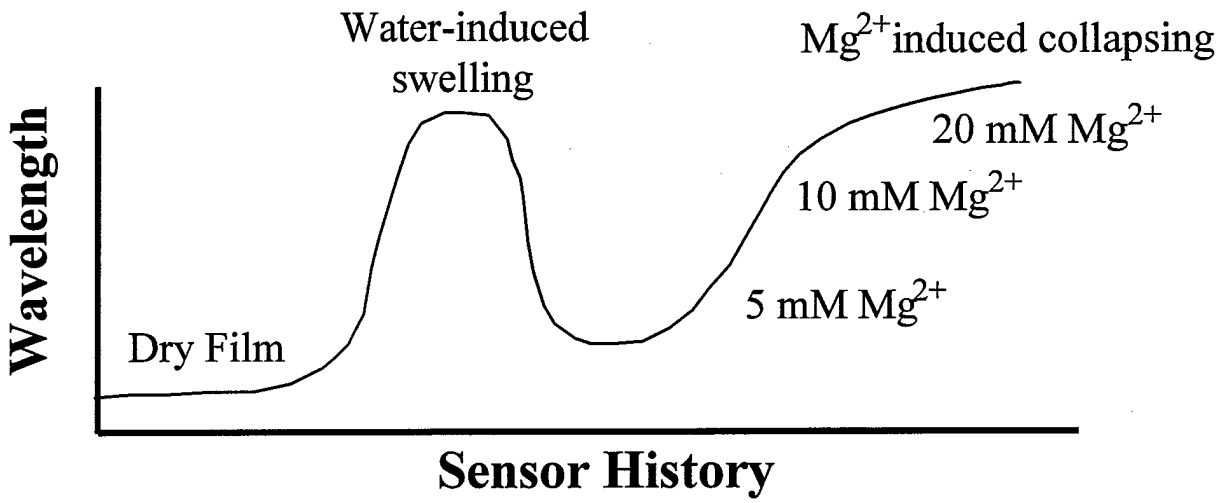

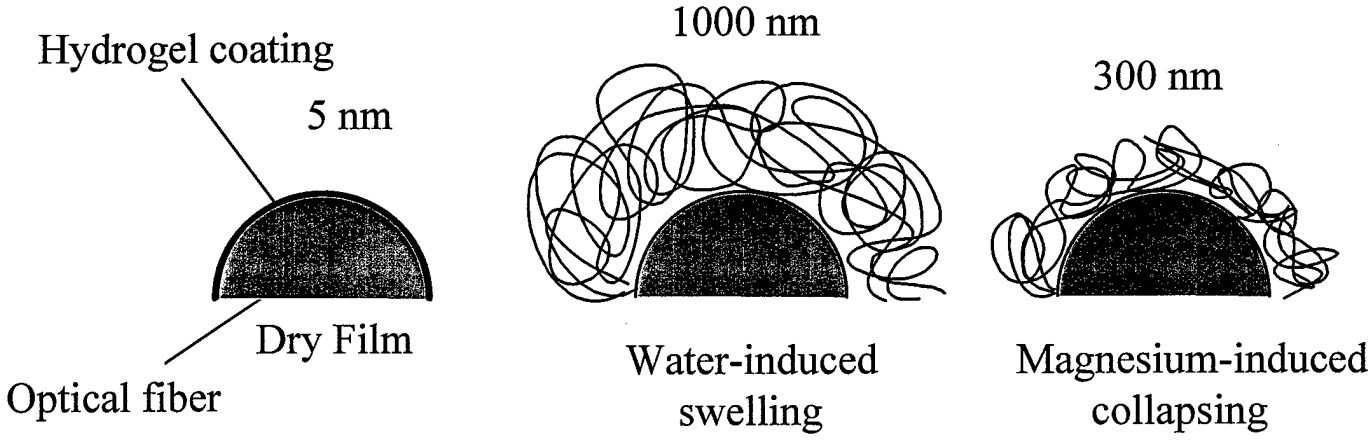

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Multiplexing Corrosion Sensors

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